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Research Article

Teaching Effectiveness and Students' Academic Performance in Biology Practical in High Schools in Fako Division, South West Region of Cameroon

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Abstract

The study investigated teaching effectiveness and students' academic performance in biology practical in high schools in Fako Division in the South West Region of Cameroon. The specific research objectives were to find out the effect of biology Teacher's competence in practical on students' academic performance in biology practical in high schools in Fako Division; and to find out the effect of biology practical teaching methods on students' academic performance in biology practical in high schools in Fako Division. The specific research objectives were later transformed into specific research questions and specific research hypotheses. The study adopted a sequential exploratory design. Quantitative data were collected from 291 biology students by means of a questionnaire, while qualitative data were collected from 12 biology teachers using an interview guide. The biology students and the biology teachers who made the sample were from six high schools in Fako Division. The data generated from the questionnaires were analysed descriptively and inferentially. While those from the interviews were analysed thematically. The findings revealed that biology teacher's competence in practical have no significant effect on students' academic performance in biology practical in high schools in Fako Division, while biology practical teaching methods have a significant effect on students' academic performance in biology practical in high schools in Fako Division. Based on the findings, it was recommended that biology teachers should be trained and sensitized via seminars and workshops on the teaching methods to use during biology practical.

Keywords: *Teaching Effectiveness, Biology Practical, Teacher's Competence, Teaching Methods, Academic Performance.*

Introduction

According to Saumya et al., (2021), academic performance is the knowledge gained by the student which is a teacher assesses by marks and/or educational goals set by students and teachers to be achieved over a specific period of time. Narad and Abdullah (2016), hold the view that academic performance is the knowledge gained assessed by marks by a teacher. Baker and Salter (2015) say that academic performance is the measurable outcomes of a student's educational experience, typically represented by grades and test scores. Students' academic performance in biology practical is the knowledge gained by biology students during biology practical, as assessed by marks or grades by biology teachers. Students' academic performance in biology practical is of great importance as it measures their mastery of the subject matter and their overall performance in the subject. This in turn enables them to pursue careers in biology related disciplines. The academic performance of students in biology practical might be influenced by a variety of factors such as teaching effectiveness particularly teacher's competence in biology practical and teaching methods used during biology practical.

According to Wambugu and Kerano (2020), practical work in science involves students finding out, learning, and verifying through observation and experiment, using skills and methods that are used by scientists in the real world. Practical activities in biology provide opportunities for students to actually do science as opposed to learning about science (Aina & Onajite, 2023). Practical activities are strategies that could be adopted to make the task of a teacher more real to the students as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matter using varieties of instructional materials. Practical work occupies an important place in the education of scientists and

engineers. Harris et al., (2002) opine that for students to perform well in Biology, practical work must be at the center of the teaching/learning process. Science educators have designed laboratory activities with the intention of promoting student learning in cognitive, affective, and psychomotor domains such as understanding scientific concepts, interest and motivation, scientific skills, scientific inquiry, and understanding the nature of science (Holland & Davies, 2020). Students who experienced hands-on laboratory programmes achieved higher scores on mid-term and final science examinations than those who did not participate in such courses. The laboratory is a space of knowledge which primarily serves to establish new scientific facts (Schmidgen, 2025). The main purpose of laboratory teaching is to provide students with conceptual and theoretical knowledge to help them learn scientific concepts through scientific methods, and to understand the nature of science (Wilson et al., 2018). The cardinal objectives of biology education are to prepare students to acquire: adequate laboratory and field skills in biology; meaningful and relevant knowledge in biology, ability to apply scientific knowledge to everyday life in matter of personal and community health and agriculture and lastly reasonable and functional scientific attitudes **(**Fadzil & Saat 2020**)**.

Teacher competence refers to a teacher's ability to manage learning, which includes the ability to develop a learning system, interact or manage the learning process and conduct assessments. **(**Kurnia-Irmawati et al, 2017**)**. Teachers' competencies are the knowledge, skills, and attitudes that educators must possess to effectively facilitate learning (Cochran-Smith 2021). Teachers who instruct biology practical must possess a range of competencies to effectively facilitate student learning and engagement. According to Urban et al., (2012), key competencies include: knowledge of biological concepts, practical skills in laboratory techniques, planning and organization, assessment and feedback, adaptability and resourcefulness, facilitation of student-centered learning, and continuous professional development

Teaching methods comprise the principles and methods used by teachers to enable student learning (Tambo, 2012). These methods are determined partly by the subject matter to be taught and partly by the nature of the learners. According to Hattie and Donoghue (2018), effective teaching methods are those that actively engage students and promote deeper understanding. Bada and Jita, (2021) opine that the fundamental principle on which laboratory teaching is based is that students teach themselves and each other. Although the students essentially learn through their own efforts, it is the instructor who provides the experiments, tasks, instructions and guidelines.

Yara (2010) compares groups of students who worked cooperatively, competitively, and as individuals in science laboratories and found that the cooperative group outperformed the other groups in cognitive achievement and in process skills. Yoadei (2024) maintained that laboratory teaching and learning activities should engage the students in hands-on and mind-on activities, using varieties of instructional materials. By engaging in hands-on activities, experiments, and real-world applications, students develop a deeper understanding of biological principles (Khoronko & Bondarenko, 2022). Inquiry-based learning fosters curiosity, critical thinking, and collaboration, promoting a student-centered approach to learning (Yonwong et al., 2024). Developing students' critical thinking, problem-solving, and scientific research skills is one of the main advantages of implementing inquiry-based learning in biology classes. Inquiry-based learning surpasses traditional lecture-based instruction in terms of increasing student motivation and engagement **(**Mwini et al., 2026). Inquiry-based learning enables students to “learn by doing” and improves their comprehension of biological ideas and ability to draw connections between them by imitating the scientific research process (Yonwong et al., 2024).

Through group discussions, problem-solving tasks, and collaborative projects, students develop communication skills, teamwork, and a sense of collective achievement (Susuoroka et al., 2023). Cooperative learning enhances student engagement and motivation, leading to improved academic performance in biology (Tarmizi & Bayat, 2016). According to Armstrong et al. (2017), encouraging students to think critically, solve problems, and conduct scientific research is one of the main advantages of implementing cooperative learning in biology classes. There are suggestions on the design and selection of teaching methods that take into account not only the nature of the subject matter but also how students learn (Fletcher, 2018). Teacher competence refers to the overall ability and authority of teachers in carrying out their profession, including responsibilities in educating students with knowledge and skills **(**Cochran-Smith 2021). It encompasses various competencies such as pedagogical, personal, social, and professional competencies, which are essential for teachers to become ideal and professional educators. These competencies enable teachers to effectively bring about intended changes in the behavior of learners and support the teaching and learning process. This study seeks to examine the link between teaching effectiveness in terms of teacher’s competence and biology practical teaching method, and students’ academic performance in biology practical.

Theoretical Framework

The theoretical framework of this study was based on the Resource Theory of Pedagogy by Fiedler and Garcia (1987) and the Experiential learning theory by David Kolb (1976). The Resource Theory of Pedagogy by Fiedler and Garcia (1987) use the term resources to includes a wide range of ingredients believed to enhance student learning: physical facilities (laboratories, libraries, and audiovisual aids), human resources (well-trained faculty members, counselors, and support personnel), and fiscal resources (financial aid, endowments, and extramural research funds). In effect, the resource theory maintains that if adequate resources are brought together in one place, student learning and development

will occur. Many college administrators believe that the acquisition of resources is their most important duty. One resource measure that is particularly popular is the student-faculty ratio. Many administrators believe that the lower the ratio, the greater the learning and personal development that will occur.

Experiential learning theory by David Kolb (1976). Under the Experiential Learning Cycle, there are four stages: concrete experience, reflective observation, abstract conceptualism, and active experimentation. Kolb believed that one must first encounter a new experience, and then reflect upon that experience. These two steps lead to a new idea or a new concept arising within the person due to analyzing and drawing conclusions upon their reflection. The last part of the Experiential Learning Cycle that Kolb theorized is that a person will then apply the new ideas, concepts, conclusions, and analyses to the world around them. Kolb believed that a person can enter this cycle at any stage, but in order for the best learning to occur, a learner must experience all stages of the cycle.

Statement of the Problem

It is the expectation of education stakeholders that teachers will teach students biology practical adequately based on their training. When competent teachers use the right teaching methods to teach biology practical, it is likely that students will perform their best in biology practical.

Perhaps some biology teachers are not competent enough in the teaching of biology practical. It is that some biology teachers may not be using the adequate teaching methods that can enable students perform well. These could result in students failing in biology and also in their end of course examination such as the General Certificate of Education (GCE) examination. It could also result in students not being able to pursue further studies in biology related disciplines.

Methodology

A sequential exploratory research design was used for this study. It made use of a mixed approach with both qualitative and quantitative methods. A sample size of 291 high school biology students and 12 biology teachers were used for the study. Two instruments were used; a questionnaire for high school biology students and an interview guide for biology teachers. Descriptive statistics and inferential statistics were used to analyse data from the questionnaire, while thematic analysis was used to analyse data from the interview guide.

Findings

The findings of the study were based on two research questions.

Research Question One: What is the effect of biology teacher competence in practical on students' academic performance in high schools in Fako Division?

The findings here reveal the effect of biology teacher competence in practical on students' academic performance

Table 1
Biology teacher competence in practical

Opinion statements	Stretched				Collapsed	
	(SA)	(A)	(D)	S.D	SA/A	D/SD
Our teacher ensures our safety during biology practical	60 (20.6%)	132 (45.4%)	59 (20.3%)	23 (07.9%)	99 (34.0%)	192 (66.0%)
During practical, the teacher ensures all students are following up	125 (43.5%)	44 (15.1%)	75 (25.8%)	47 (16.2%)	169 (58.1%)	122 (41.9%)
Our teacher is skilled in dissecting	78 (26.8%)	131 (45.0%)	59 (20.3%)	23 (07.9%)	209 (71.8%)	82 (28.2%)
We understand the teacher during biology practical	51 (17.5%)	97 (33.3%)	87 (29.2%)	56 (19.3%)	148 (50.9%)	143 (49.1%)
Our teacher encourages collaboration and team work during biology practical	22 (07.6%)	25 (08.6%)	143 (49.1%)	101 (34.7%)	47 (16.2%)	244 (83.8%)
Our biology teacher is hostile towards us especially during biology practical	53 (18.2%)	58 (19.9%)	96 (33.9%)	84 (28.9%)	111 (38.1%)	180 (61.9%)
Multiple response set (MRS)	**389 (22.3%)**	**487 (27.9%)**	**519 (29.7%)**	**351 (20.1%)**	**876 (50.2%)**	**870 (49.8%)**

Based on the items, minority (34.0%) of the respondents strongly agreed and agreed that their teacher ensures their safety during biology practical, whereas, most (66.0%) respondents disagreed to the motion.

Likewise, majority (58.1%) of the respondents agreed that during practical, the teacher ensures all students are following up, whereas some (41.9%) respondents disagreed and strongly disagreed. Moreover, most (71.8%) of the respondents agreed that their teacher is skilled in dissecting. Meanwhile few (28.2%) of the respondents disagreed on the opinion. Besides 148 (50.9%) strongly agreed and agreed that they understand the teacher during biology practical. On the other hand, almost half (49.1%) of the respondents strongly disagreed and disagreed to the opinion.

In addition, few (16.2%) of the respondents agreed that their teacher encourages collaboration and team work during biology practical, while most (83.8%) disagreed. Lastly, some (38.1%) respondents agreed that their biology teacher is hostile towards them especially during biology practical, meanwhile, majority (61.9%) of the respondents disagreed to the opinion, implying that their biology teacher is not hostile towards them especially during biology practical. The findings from table 14 above indicates from the Multiple response set (MRS) that some (50.2%) of the respondents strongly agreed and agreed that biology teacher competences in practical affects students' academic performance, while the almost half (49.8%) respondents disagreed.

Verification of Hypothesis One

Ho_1: Biology teacher competence in practical has no significant effect on students' academic performance in high schools in Fako Division.

Ha_1: Biology teacher's competence in practical has a significant effect on students' academic performance in high schools in Fako Division.

To further determine the effect of biology teacher competence in practical on students' academic performance, the Pearson chi-square coefficient was calculated to ascertain the effect as indicated on the table below.

Table 2
Chi-Square Correlation Test for Biology teacher competences in practical and students' academic performance

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	**32.247[a]**	25	**.062**
Likelihood Ratio	84.378	25	.000
Linear-by-Linear Association	35.083	1	.000
N of Valid Cases	291		
a: 6 cells (38.9%) have expected count less than 5. The minimum expected count is 1.03			

The table above presents the Chi-square correlational statistics computed to match biology teacher competences in practical and students' academic performance, at a 0.05 level of significance. As shown, with a degree of freedom of 25 (df= 25), the chi-square coefficient (X^2) was found to be 32.247 and the critical value was 0.062. Since $X^2 = 32.247$ and $p > 0.05$, there exists no significant correlation between biology teacher competence in practical and students' academic performance. Which implies students' academic performance does not increase each time biology teacher competence in practical increases.

Judging from the above, we fail to reject the null hypothesis. Therefore, there is enough statistical evidence that Biology teacher competence in practical have no significant effect on students' academic performance in high schools in Fako Division.

Table 3
Teachers' opinion on the effect of biology teacher competence in practical on students' academic performance

Codes	Themes	Sampled quotations
Skills which teachers exhibit during biology practical	Communication skills	
	Collaborative skills	
	Guidance skills	
	Demonstrative skills	"demonstration skills e.g. by showing how to mount a slide on a microscope, instructional guidance"
	Safety skills	
	Equipment management	
	Problem solving skills	

Influence of teacher's laboratory skills on students' performance in biology practical.	Makes students to be inquisitive	"positively, collaboration will make students ask questions which they will be giving answers by teachers which will help them improve in their performance"
	Increases students' participation	"it affects it positively in that there is engagement among students that helps to increase participation leading to high performance" "these skills enhance interactive teaching and make students excited to learn more that enhances performances" "it enhances participation among the teacher and the students in carrying out practical exercises" "these skills enhances interactions between the teacher and learners thereby increasing active participation of students leading to high performance"
	Makes students to perform experiments well	"demonstration helps students to understand and perform experiments well" "it enhances active engagement thereby increasing understanding and performance of biology experiments" "it will really affect students' performance because will turn to trust in you as an expert or someone that can support them to know practical exercises thereby leading to high performance of students" "being a guidance, support and boosts students' confidence in carrying out practical exercises thereby improving performance" "positively, communication between the teachers and students will improve their performance since the teacher will be asking them questions and the students will be given their answers too"

The table above presents information on the effect of biology teacher competence in practical on students' academic performance. From the table, teachers exhibit the following skills during biology practical; communication skills, collaborative skills, guidance skills, demonstrative skills, safety skills, equipment management skills, and problem solving skills.

Considering the influence of the above listed skills on students' performance in biology practical, respondents opined that it increases students' participation as testified by participants 4, 8, 9 and 12 ; "*it affects it positively in that there is engagement among students that helps to increase participation leading to high performance*"; "*these skills enhance interactive teaching and make students excited to learn more that enhances performances*"; "*it enhances participation among the teacher and the students in carrying out practical exercises*"; "*these skills enhance interactions between the teacher and learners thereby increasing active participation of students leading to high performance*".

In addition, others opined that the above listed skills exhibited by teachers during biology practical makes students to perform experiments well. Some of their direct responses according to participants 2, 3, 8, 10 and 11 were; "*demonstration helps students to understand and perform experiments well*"; "*it enhances active engagement thereby increasing understanding and performance of biology experiments*"; "*it will really affect students' performance because they will turn to trust in you as an expert or someone that can support them to know practical exercises thereby leading*

to high performance of students"; "*it guides, supports and boosts students' confidence in carrying out practical exercises thereby improving performance*"; "*positively, communication between the teachers and students will improve their performance since the teacher will be asking them questions and the students will be giving their answers too*"

Summarily based on the effect of biology teacher practical competences on students' academic performance, the respondents asserted that teachers exhibit the following skills during biology practical; communication skills, collaborative skills, guidance skills, demonstrative skills, safety skills, equipment management skills, and problem solving skills. The listed skills are very instrumental in ensuring a favorable students' performance during biology practical as they increase students' participation and makes students to perform experiments well.

Research Question Two: What is the effect of biology practical teaching methods on students' academic performance in high schools in Fako Division?

The findings here reveal the effect of biology practical teaching methods on students' academic performance

Table 4
Biology practical teaching methods

Opinion statements	Stretched				Collapsed	
	(SA)	(A)	(D)	S.D	SA/A	D/SD
I discover new things each time I perform tasks/experiments in the lab	100 (34.4%)	96 (33.9%)	65 (22.3%)	30 (10.3%)	196 (67.4%)	95 (32.6%)
Some of us are appointed by the teacher to explain tasks to our fellow students who don't understand	67 (23.0%)	114 (39.2%)	82 (28.2%)	28 (09.6%)	181 (62.2%)	110 (37.8%)
Our teacher allows us to learn dissecting on our own	52 (17.9%)	70 (24.1%)	115 (38.5%)	54 (18.6%)	122 (41.9%)	169 (58.1%)
I do my personal research about dissecting before going to the lab	83 (28.5%)	126 (43.3%)	61 (21.6%)	21 (007.2%)	209 (71.8%)	82 (28.2%)
Our teacher explain to us how dissecting is done using a specimen	96 (33.8%)	76 (26.1%)	77 (26.5%)	42 (14.4%)	172 (59.1%)	119 (40.9%)
Our biology teacher does all the talking during biology practical	22 (07.6%)	51 (17.5%)	124 (42.6%)	94 (32.3%)	73 (25.1%)	218 (74.9%)
Multiple response set (MRS)	420 (24.1%)	533 (30.5%)	524 (30.0%)	269 (15.4%)	953 (54.6%)	793 (45.4%)

Based on the items, 196 (67.4%) strongly agreed and agreed that they discover new things each time they perform tasks/experiments in the laboratory. On the other hand, 95 (32.6%) of the respondents strongly disagreed and disagreed to the opinion.

Likewise, majority (62.2%) of the respondents agreed that some of them are appointed by the teacher to explain tasks to their fellow students who don't understand, whereas some (37.8%) respondents disagreed and strongly disagreed. Moreover, minority (41.9%) of the respondents agreed that their teacher allows them to learn dissecting on their own. Meanwhile most (58.1%) of the respondents disagreed on the opinion. Most (71.8%) of the respondents strongly agreed and agreed that they do their personal research about dissecting before going to the laboratory, whereas, minority (28.2%) of the respondents disagreed to the motion. In addition, majority (59.1%) of the respondents agreed that their teacher explains to them how dissecting is done using a specimen, while some (40.9%) disagreed. Lastly, few (25.1%) respondents agreed that their biology teacher does all the talking during biology practical, meanwhile, majority (74.9%) of the respondents disagreed to the opinion. The findings from table 4 above indicates from the multiple response set (MRS) that majority (54.6%) respondents strongly agreed and agreed that Biology practical teaching methods affect students' academic performance, while minority (45.4%) of the respondents disagreed which indicates that Biology practical teaching methods positively affect students' academic performance.

Verification of research hypotheses two

Ho_2: Biology practical teaching methods have no significant effect on students' academic performance in high schools in Fako Division

Ha_2: Biology practical teaching methods have a significant effect on students' academic performance in high schools in Fako Division

To further determine the effect of Biology practical teaching methods on students' academic performance, the Pearson chi-square coefficient was calculated to ascertain the effect as indicated on table 5 below.

Table 5
Chi-Square Correlation Test for Biology practical teaching methods and students' academic performance

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	79.201[a]	25	**.040***
Likelihood Ratio	84.579	25	.000
Linear-by-Linear Association	46.322	1	.000
N of Valid Cases	291		
a: 6 cells (16.7%) have expected count less than 5. The minimum expected count is 2.16.			

Table 5 above presents the Chi-square correlational statistics computed to match Biology practical teaching methods and students' academic performance, at a 0.05 level of significance (p=0). As shown, with a degree of freedom of (df= 25), the chi-square correlation coefficient (X^2) was found to be 79.201 and the critical value was 0.040. Since $X^2 = 79.201$ and $p < 0.05$, there exists a significant effect between Biology practical teaching methods and students' academic performance. This implies that the more or less Biology practical teaching methods are used, the more or less students' academic performance are ensured.

Judging from the above, the null hypothesis will be rejected and the alternative hypotheses retained. There is therefore enough statistical evidence that Biology practical teaching methods have a significant effect on students' academic performance in high schools in Fako Division.

Table 6
Teachers' opinion on the effect of biology practical teaching methods on students' academic performance

Codes	Themes	Sampled quotations
Methods teachers use during biology practical	Lecture illustration Lecture demonstration Collaboration method Discussion method Experimental method	
Contribution of the methods teaching adopt during biology practical on students' academic performance	Facilitates understanding of biology experiments	"collaboration will help students understand very well since the students ask questions to the teachers and the teachers answer them" "a method such as collaboration will encourage students to work together thereby increasing understanding" "different teaching methods helps students understand better since lectures and practical exercises can be exhibited in different methods" "these methods enhance understanding, thereby promoting understanding" "these methods encourage hands-on experiences, thereby promoting understanding" "different teaching methods caters for different learning styles of students which fosters understanding" "different teaching methods helps to deepen the understanding of students in different aspects in biology"
	Motivates learners	"variety of teaching methods can motivate learners and thereby also reducing boredom keeping them interested in the lesson which will therefore encourage understanding"

	"these methods motivates students by providing hands-on experiments which provide students with experiences thereby enhancing understanding" "lecture demonstration will motivate students very well, since seeing what the teacher is teaching them life"

The table above presents information on the effect of biology practical teaching methods on students' academic performance. From the table, teachers use the following methods of teaching during biology practical; lecture illustration, lecture demonstration, collaboration method, discussion method, and experimental method.

The above listed methods are instrumental in contributing to students' performance in biology practical as the respondents opined that it facilitates understanding of biology experiments and motivates learners. The direct quotations of participants 1, 4, 6, 7, 9, 10, 11 and 12 respectively were; "*collaboration will help students understand very well since the students ask questions to the teachers and the teachers answer them*"; "*a method such as collaboration will encourage students to work together thereby increasing understanding*"; "*different teaching methods help students understand better since lectures and practical exercises can be exhibited in different methods*"; "*these methods enhance understanding, thereby promoting understanding*"; "*these methods encourage hands-on experiences, thereby promoting understanding*"; "*different teaching methods cater for different learning styles of students which fosters understanding*"; "*different teaching methods help to deepen the understanding of students in different aspects in biology*"; "*variety of teaching methods can motivate learners and thereby also reducing boredom keeping them interested in the lesson which will therefore encourage understanding*"; "*these methods motivate students by providing hands-on experiments which provide students with experiences thereby enhancing understanding*"; "*lecture demonstration will motivate students very well, since they will see what the teacher is teaching them life*"

Summarily based on the effect of biology teacher practical teaching methods on students' academic performance, the respondents asserted that teachers use the following teaching methods during biology practical; lecture illustration, lecture demonstration, collaboration method, discussion method, and experimental method. The listed skills are very instrumental as they facilitate understanding of biology experiments and motivate learners.

Conclusion

Based on the findings, it was concluded that biology teacher competence in practical have no significant effect on students' academic performance in high schools in Fako Division. However, biology practical teaching methods have a significant effect on students' academic performance in high schools in Fako Division Generally, teaching effectiveness in biology practical has a significant effect on the academic performance of students in high schools in Fako Division, South West Region of Cameroon.

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